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## Preview of Award 1212753 - Final Project Report

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### Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1212753
Project Title:	CRPA: The Incipient Species Project
PD/PI Name:	John A Uy, Principal Investigator Nathan Dappen, Co-Principal Investigator Neil Losin, Co-Principal Investigator
Recipient Organization:	University of Miami
Project/Grant Period:	09/01/2012 - 08/31/2016
Reporting Period:	09/01/2015 - 08/31/2016
Submitting Official (if other than PD\PI):	John A Uy Principal Investigator
Submission Date:	02/08/2017
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	John A Uy

### Accomplishments

#### \* What are the major goals of the project?

The goals of *The Incipient Species Project* were: 1) To produce a 1-hour documentary about speciation, "Islands of Creation," focusing on Dr. Al Uy's research on *Monarcha* flycatchers in the Solomon Islands; 2) To broadcast "Islands of Creation" on U.S. and international TV networks; 3) To produce a series of short companion web films to supplement the broadcast documentary; 4) To create a dedicated project website, [incipientspecies.com](http://incipientspecies.com), containing the web films, as well as essays about speciation research written by leading speciation researchers; and 5) To conduct an external evaluation of the broadcast documentary and its impacts on viewers.

**\* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities: The evaluation firm Education Northwest completed an independent evaluation of “Islands of Creation” in January 2017. They compared two groups of participants, a treatment group who watched the film “Islands of Creation” before completing a questionnaire, and a control group who completed the questionnaire before watching the film. Responses to the questionnaires were summarized in two composite metrics: a *content* scale, which reflects participants’ understanding of evolution and speciation, and a *perception* scale, which reflects their perception and attitudes about science and scientists. The treatment group, who completed the questionnaire after watching the film, scored significantly higher than the control group on both scales. The difference between the groups was approximately 1.7 standard deviations for the *content* scale, and 0.5 standard deviations for the *perception* scale. Therefore, the film spurred a marked improvement in viewers’ content knowledge about evolution and speciation, and a more modest (but still significant) improvement in their perceptions of science.

Specific Objectives:

Significant Results:

Key outcomes or Other achievements: We finished a rough cut of the documentary “Islands of Creation” in mid 2014, after which we entered a co-production agreement with the Smithsonian Channel. Under this agreement, we finished the film in partnership with Smithsonian Channel and it first broadcast in 2015. It has since aired several times in the U.S. and abroad (via Smithsonian Channel’s international distribution partners). The film has been featured in leading film festivals (e.g. Jackson Hole Science Media Awards, American Conservation Film Festival, and International Wildlife Film Festival) and has won awards (e.g. Best Broadcast Film at ACFF, Newcomer Award at IWFF).

We completed the website IncipientSpecies.org in 2016. The website features original essays about speciation by eight leading research groups, as well as six original short films covering different aspects of Dr. Uy’s work (and research in the Solomon Islands) that were not included in the broadcast film “Islands of Creation.”

**\* What opportunities for training and professional development has the project provided?**

Nothing to report.

**\* How have the results been disseminated to communities of interest?**

This was primarily an outreach grant (AISL: CRPA), so the primary focus has been disseminating the results of PI Uy’s research to the broader public. As discussed in detail above, we have released a 1-hour broadcast documentary and launched a companion website and short films about speciation to educate audiences about this area of research.

**Supporting Files**

Filename	Description	Uploaded By	Uploaded On
EdNW_Evaluation_IslandsOfCreation.pdf	Education Northwest’s evaluation of the documentary’s effectiveness	John Uy	02/08/2017

**Products**

**Books**

**Book Chapters**

**Inventions**

**Journals or Juried Conference Papers**

**Licenses**

## Other Conference Presentations / Papers

### Other Products

*Audio or Video Products.*

"Islands of Creation" is a 1-hour broadcast documentary co-produced by Day's Edge Productions and the Smithsonian Channel. The film follows PI Uy and his research on bird speciation in the Solomon Islands. It has been broadcast in the U.S. and internationally by Smithsonian Channel and its international partners.

*Audio or Video Products.*

We produced a series of companion short films for the "Islands of Creation" broadcast documentary. These short films are featured on the project's website, IncipientSpecies.org.

*External Evaluation Report.*

Evaluation firm Education Northwest has conducted a formal evaluation of the "Islands of Creation" film and prepared a report of their findings. This final evaluation report was delivered in January 2017.

### Other Publications

#### Patents

#### Technologies or Techniques

#### Thesis/Dissertations

#### Websites

*IncipientSpecies.org*

<http://www.incipientspecies.org>

IncipientSpecies.org is a website about the science of speciation. It features original short videos about PI Uy's work in the Solomon Islands, as well as a series of essays about speciation research from leading evolutionary biologists who study speciation in a variety of model systems.

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## Participants/Organizations

### What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Uy, John	PD/PI	4
Dappen, Nathan	Co PD/PI	12
Losin, Neil	Co PD/PI	12

### Full details of individuals who have worked on the project:

#### John A Uy

**Email:** [uy@bio.miami.edu](mailto:uy@bio.miami.edu)

**Most Senior Project Role:** PD/PI

**Nearest Person Month Worked:** 4

**Contribution to the Project:** PI Uy's work was a the focus of this project. As such, he was involved in the development, production and filming of the documentary, as well as the development of the online component of the work (website).

**Funding Support:** Funding was provided by this grant, as well as an endowment from the College of Arts & Sciences, University of Miami

**International Collaboration:** No

**International Travel:** Yes, Solomon Islands - 0 years, 1 months, 6 days

**Nathan Dappen**

**Email:** nathan.dappen@gmail.com

**Most Senior Project Role:** Co PD/PI

**Nearest Person Month Worked:** 12

**Contribution to the Project:** Co-PI Dappen was a producer and director of the film "Islands of Creation," as well as a key developer of the online components of this project.

**Funding Support:** None.

**International Collaboration:** No

**International Travel:** Yes, Solomon Islands - 0 years, 1 months, 6 days

**Neil Losin**

**Email:** neil.losin@gmail.com

**Most Senior Project Role:** Co PD/PI

**Nearest Person Month Worked:** 12

**Contribution to the Project:** Co-PI Losin was a producer and director of the film "Islands of Creation," as well as a key developer of the online components of this project.

**Funding Support:** None

**International Collaboration:** No

**International Travel:** Yes, Solomon Islands - 0 years, 1 months, 6 days

**What other organizations have been involved as partners?**

Name	Type of Partner Organization	Location
Smithsonian Channel	Other Organizations (foreign or domestic)	Washington DC

**Full details of organizations that have been involved as partners:**

**Smithsonian Channel**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** Washington DC

**Partner's Contribution to the Project:**

Financial support

Facilities

**More Detail on Partner and Contribution:** The Smithsonian Channel helped us with post-production. Our film, Islands of Creation ended up becoming a co-production between Day's Edge Productions and the Smithsonian Channel.

**What other collaborators or contacts have been involved?**

Nothing to report

**Impacts**

**What is the impact on the development of the principal discipline(s) of the project?**

The film "Islands of Creation" was intended to be a resource for the general public to learn about the science of speciation and be inspired and entertained by cutting-edge science.

The evaluation firm Education Northwest completed an independent evaluation of "Islands of Creation" in January 2017. They compared two groups of participants, a treatment group who watched the film "Islands of Creation" before completing a questionnaire, and a control group who completed the questionnaire before watching the film. Responses to the questionnaires were summarized in two composite metrics: a *content* scale, which reflects participants' understanding of evolution and speciation, and a *perception* scale, which reflects their perception and attitudes about science and scientists. The treatment group, who completed the questionnaire after watching the film, scored significantly higher than the control group on both scales. The difference between the groups was approximately 1.7 standard deviations for the *content* scale, and 0.5 standard deviations for the *perception* scale. Therefore, the film spurred a marked improvement in viewers' content knowledge about evolution and speciation, and a more modest (but still significant) improvement in their perceptions of science.

In summary, our evaluation of "Islands of Creation" was a case study that demonstrated the film to be effective at educating audiences about a specific area of biology (speciation) and improving their perceptions and attitudes about science. However, developing comparative tests of "Islands of Creation" as compared to other outreach products is outside the scope of this grant.

**What is the impact on other disciplines?**

Nothing to report.

**What is the impact on the development of human resources?**

Nothing to report.

**What is the impact on physical resources that form infrastructure?**

Nothing to report.

**What is the impact on institutional resources that form infrastructure?**

Nothing to report.

**What is the impact on information resources that form infrastructure?**

Nothing to report.

**What is the impact on technology transfer?**

Nothing to report.

**What is the impact on society beyond science and technology?**

As discussed above, the television broadcast and film festival distribution of "Islands of Creation" brought the film to large audiences. Based on our formal evaluation of the film, we have reason to believe that viewers gained a better understanding of speciation, and improved their perceptions and attitudes about science.

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## Changes/Problems

**Changes in approach and reason for change**

Nothing to report.

**Actual or Anticipated problems or delays and actions or plans to resolve them**

Nothing to report.

**Changes that have a significant impact on expenditures**

Nothing to report.

**Significant changes in use or care of human subjects**

Nothing to report.

**Significant changes in use or care of vertebrate animals**

Nothing to report.

**Significant changes in use or care of biohazards**

Nothing to report.

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**Special Requirements**

**Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.**

Nothing to report.

Prepared:  
Neil Losin (Day's Edge Productions)  
Nathan Dappen (Day's Edge Productions)  
John Albert C. Uy (University of Miami)  
December, 2016

### Introduction

This brief provides the method, analyses and results of a randomized-controlled trial to evaluate the impact of the *Islands of Creation* documentary on viewers' knowledge of speciation and their perceptions of science and scientists in general. The creation of the documentary was funded under the auspices of the National Science Foundation (NSF) grant. Evaluators from Education Northwest worked collaboratively with the creators of the documentary. The data sources for this brief includes responses on two surveys, participants who watched the documentary prior to completing the survey (known henceforth as treatment group) and participants who completed the survey prior to watching the documentary (known henceforth as control group).

### Background

Scientists across the nation are engaged in creatively informing the public on scientific knowledge and processes, and the importance of their findings. Scientists need to communicate their life's work compellingly if they are to engage the general public.

Currently participant numbers entering STEM fields in college are quite low (National Research Council, 2011). As the nation's growing need for STEM professionals remains unmet, it becomes increasingly urgent that more innovative methods are required to make science careers more prominent and exciting. One way to engage the general public in scientific discourse is to provide tools that are entertaining, meaningful and content specific. The *Islands of Creation* documentary was developed with this aim, in order to reveal the unseen world of one scientist's work that will illuminate, captivate and entertain audiences.

The developers of the report, "A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas" (2011) that guided the development of the Next Generation Science Standards (NGSS) envisioned two major goals: first, is to educate all participants in science and engineering and second to provide the foundational knowledge for participants who are interested in pursuing scientific and engineering careers in the future. The documentary demonstrates the importance of this vision. Audiences will get to see scientific discovery up close through the eyes of one scientist.

*"...it is built on the notion of learning as a developmental progression. It is designed to help children continually build on and revise their knowledge and abilities, starting from their curiosity about what they see around them and their initial conceptions about how*

*the world works.*”--A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas

The documentary demonstrates the scientific and engineering practices in real life.

*“...the framework emphasizes that learning about science and engineering involves integration of the knowledge of scientific explanations (i.e., content knowledge) and the practices needed to engage in scientific inquiry and engineering design.”*

--A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas

The documentary captures the essence of an exciting field (speciation and evolution), expressing the enthusiasm and wonder that scientist Alan Uy feels when working with the bird species in the Solomon Islands.

### **Evaluation Questions**

1. What is the difference in the average content knowledge between the treatment and control groups?
2. What is the difference in the average perception about science and scientists between the treatment and control groups?
3. What is the difference in the average confidence level in scientists between the treatment and control groups? – This question is answered descriptively as only one item was used for the analysis.

### **Method**

The impact study of the “Islands of Creations” documentary employed a randomized controlled trial (RCT) design, with assignment at the participant level. Participants were randomly assigned to either the control condition or to the treatment condition.

### **Instrument**

The study examined the impact of the documentary using a researcher-developed survey consisting of 22 items with two distinct scales: *content* (14 items) and *perception* (7 items). The content items are binary, if participant gets a correct answer it has a score of 1. The maximum score a participant can obtain is therefore 14 points. For the perception scale, each item is rated on a Likert scale from 1 to 5. A higher rating is more positive perception of science and scientists. Items that were negatively worded were reverse coded. The participants’ average rating on the 7 items were used as the score for the perception scale. One item related to participant’s confidence in scientists was analyzed separately. The survey was administered on two separate days in November, 2016. The Cronbach’s alpha is used as a scale reliability index, an alpha value of 1 shows perfect internal consistency and a value of 0 shows no internal consistency among the items, therefore a value closer to 1 is more desirable. Scales with alpha



values above 0.80 are considered to have strong internal consistency. The 14 items making up the content scale has an alpha value of 0.88 showing good internal consistency. The total score was used as a measure of a single unidimensional content construct. The perception construct also has strong internal consistency (alpha=0.89).

#### Random Assignment Procedure

Participants ( $N=90$ ) were recruited from Portland, Oregon through the evaluator’s relationship with schools staff, colleagues and visitors to the science museum. After collecting the lists of participants, the evaluator randomly assigned all eligible participants using equal proportions: 50 percent were assigned to the treatment and 50 percent were assigned to the control group within the three regions. All participants completed the survey. There was no attrition because the evaluator had close supervision of all participants. All were aged 25 years or older, and had at least a high school diploma. Almost equal numbers of males and females were in the treatment and control group providing.

#### Outcome Measures

The evaluation examined three distinct outcomes measures:

- *Content* knowledge on speciation
- *Perception* about science and scientists
- *Confidence* in scientists

Table 1: Descriptive statistics for content construct

	Female			Male		
	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>
Control	21	4.52	3.03	24	5.38	2.16
Treatment	23	12.96	0.82	22	10.73	1.28

Note: range of score is between 1(lowest) and 14 (highest).

Table 2: Descriptive statistics for perception construct

	Female			Male		
	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>
Control	21	4.29	0.65	24	4.29	0.64
Treatment	23	4.86	0.12	22	4.66	0.14

Note: range of score is between 1(lowest) and 5 (highest).

## Impact Analysis

To determine the statistical significance of the effect on the *content* and *perception* constructs we employed a regression model statistically controlling for any gender effect. In the second analysis, we included an interaction effect between the treatment and gender variables while keeping all other elements of the first model the same. The interaction effect if statistically significant shows there is a differential impact of the intervention on male and females participants.

## **Results**

The main effect for the documentary was statistically significant at the 0.05 alpha-level for the *content* and *perception* outcomes. Participants in the treatment group on average scored 6.86 points higher than their control counterparts on the content scale, and also scored 0.47 points higher on the perception construct than control participants. To determine how big this effect is we used Hedges'  $g$  (Hedges, 1981) to estimate the effect size of the difference in means between the treatment and control participants. Participants in the treatment group on average scored more than one and the half standard deviation ( $d=1.69$ ) higher than their counterparts in the control group on the content scale, and about half a standard deviation on the perception scale ( $d=0.51$ ).

In terms of percentile ranking this translates to a participant improving from the 50<sup>th</sup> percentile to at least the 90<sup>th</sup> percentile on the content scale, and improving to at least to the 70<sup>th</sup> percentile on the perceptions scale (Lipsey et al., 2012).

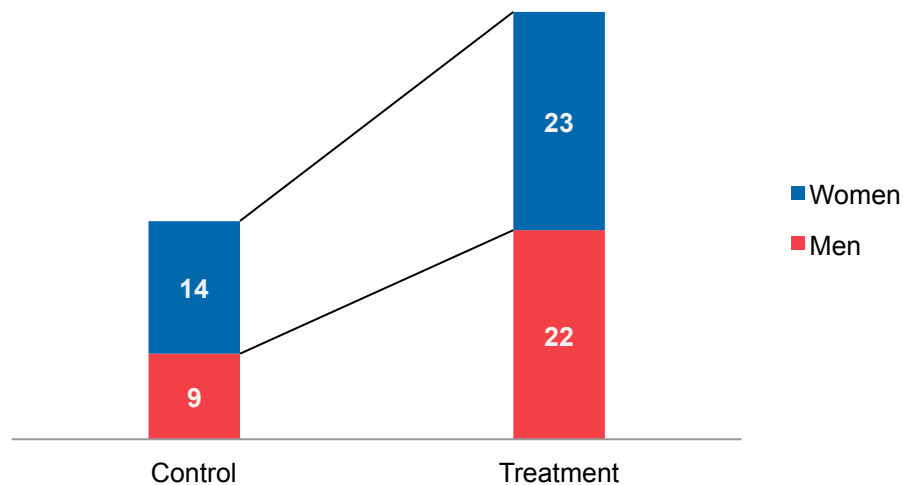
## Subgroup Analysis

To investigate whether watching the documentary had a differential impact on male or female participants, we conducted a subgroup analysis. The interaction effect was statistically significant for the content outcome at the 0.05 alpha-level but was not statistically significant for the perception outcome. For the content outcome, the treatment had a stronger effect on female participants. Female participants benefited by about 3 points (about half a standard deviation) more than male participants did due to the treatment's differential impact on gender.

## Confidence in Scientists

All participants in the treatment group reported having high confidence in scientists and around half of the participants in the control group reported having high confidence in scientists while the other half reported having confidence in scientists. In the control group there were 9 men participants reported having strong confidence in scientists while 14 women participants reported having strong confidence in scientists. In the treatment group all men and women participants reported they having strong confidence in scientists.

Figure 1: Documentary's impact on confidence in scientists. Number of participants reporting strong confidence in scientists



## Discussion

Results show that the viewing the documentary had a substantial effect on viewers’ knowledge on speciation. Because speciation is a specialized area of the life sciences, participants may have little to no knowledge on this topic area. Only after watching the documentary would allow them to answer the items correctly. On average participants from this study reported good perceptions on science and scientists, and also reported high confidence in scientists, therefore the impact of the documentary on participants was smaller than the impact on the content scale.

## Recommendations

Although the results have strong internal validity, its findings are specific only to the population the evaluator studied. All participants were recruited within the Portland area. The next step is to broaden the pool of participants from several other locations. It is also valuable to see how high school students respond to the surveys. If the findings are similar then teachers will have an additional tool to engage students and improve student literacy in the sciences.

The second recommendation is to study the long term impact of viewing the documentary on participants’ content knowledge.

## References

Lipsey, M. W., Puzio, K., Yun, C., Hebert, M. A., Steinka-Fry, K., Cole, M. W., & Busick, M. D. (2012). Translating the Statistical Representation of the Effects of Education Interventions into More Readily Interpretable Forms. *National Center for Special Education Research*.

Hedges, L. V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational and Behavioral Statistics*, 6(2), 107-128.

Quinn, H., Schweingruber, H., & Keller, T. (Eds.). (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. National Academies Press.

## Technical Appendix

The following linear regression model was employed (using a total score for the content knowledge items and the total for the perception scores as the outcome).

### Impact Analysis Model

$$Y = \beta_0 + \beta_1 \textit{Treatment} + \beta_2 \textit{Gender} + \epsilon$$

Where

Y	is the total score of the participant either content knowledge or the average score on the perception of science and scientists
$\beta_0$	is the gender adjusted outcome for participants in the control group
$\beta_1$	is the average effect of the Islands of Creation documentary intervention:
Treatment	is a dummy variable indicating participant treatment status (1 if randomized to treatment and 0 if control).
$\beta_2$	is the effect of Gender
Gender	is the participant's gender (1=male, 0=female).
$\epsilon$	is the error term (the deviation between the participant's observed and predicted outcomes).

The second model is to estimate the differential treatment effect on males and females.

### Subgroup Analysis Model

$$Y = \beta_0 + \beta_1 \textit{Treatment} + \beta_2 \textit{Gender} + \beta_3 \textit{Treatment} * \textit{Gender} + \epsilon$$

Where

Y	is the total score of the participant either content knowledge or the average score on the perception of science and scientists
$\beta_0$	is the gender adjusted outcome for participants in the control group
$\beta_1$	is the average effect of the Islands of Creation documentary intervention:
Treatment	is a dummy variable indicating participant treatment status (1 if randomized to treatment and 0 if control).
$\beta_2$	is the effect of Gender adjusted for treatment and interaction effect
Gender	is the participant's gender (1=male, 0=female).
$\beta_3$	is the <i>differential</i> effect of treatment (subgroup)
$\epsilon$	is the error term (the deviation between the participant's observed and predicted outcomes).

Table 1A: Regression coefficients for the two models – *Content knowledge*

Variables	Impact Analysis Model		Subgroup Analysis Model	
	<i>Coefficient</i>	<i>Standard Error</i>	<i>Coefficient</i>	<i>Standard Error</i>
Intercept ( $\beta_0$ )	5.35***	0.40	4.52***	0.43
Treatment ( $\beta_1$ )	6.86***	0.45	8.43***	0.60
Gender ( $\beta_2$ )	-0.69n.s.	0.45	0.85n.s.	0.59
Treatment x Gender ( $\beta_3$ )	-	-	-3.08***	0.84
R <sup>2</sup>	0.73	-	0.77	-

\*\*\* p < 0.001 and n.s. – not significant, p > 0.05

Table 1B: Regression coefficients for the two models – *Perception on science and scientists*

Variables	Impact Analysis Model		Subgroup Analysis Model	
	<i>Coefficient</i>	<i>Standard Error</i>	<i>Coefficient</i>	<i>Standard Error</i>
Intercept ( $\beta_0$ )	4.34***	0.10	4.29***	0.10
Treatment ( $\beta_1$ )	0.47***	0.10	0.57***	0.14
Gender ( $\beta_2$ )	-0.10n.s.	0.10	< 0.01n.s.	0.14
Treatment x Gender ( $\beta_3$ )	-	-	-0.19n.s.	0.20
R <sup>2</sup>	0.22	-	0.23	-

\*\*\* p < 0.001 and n.s. – not significant, p > 0.05

### Calculation of Hedges' $g$

The effect size is calculated by dividing the differences in means or the regression coefficients by the pooled standard deviation for the sample. Pooled standard deviation is calculated as follows:

$$\text{Pooled standard deviation} = \sqrt{\frac{(n_t - 1)s_t^2 + (n_c - 1)s_c^2}{n_t + n_c - 2}}$$

Where  $n_t$  and  $n_c$  are the sample sizes of the treatment and control conditions, respectively, and similarly  $s_t$  and  $s_c$  are the unadjusted individual level standard deviations of the treatment and control conditions, respectively.